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ABSTRACT

This study investigated the problem of teacher thinking in interactive class teaching situations. A sample of 21 elementary and middle school teachers in Spain was studied through a multi-method triangulation involving observation, interviews, and daily journals. Verbal protocol from different sources led to the identification of 510 elements that summarized teachers' interactive actions. Detailed analysis of the elements is presented in this report of the study's two phases. The first phase analyzed ten element networks (motivation, creativity, use of ideas, use of resources, activity, practice, rigidity, directivity, socialization, and multidirectional communication) and application of four constructs to three teachers, of science, mathematics and language. The second phase involved descriptions of the constructs and reflections-in-action of three teachers in interactive teaching. (Author/CB)

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# DIAGNOSTIC EVALUATION OF TEACHERS' MENTAL PROCESSES

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* This paper is a brief summary of a research project between the Universities of Seville ( Spain ) and Cincinnati , Ohio .

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SUMMARY

This research project approaches the problem of teacher thinking in interactive class teaching. A sample of 21 Spanish Elementary and Middle School teachers in practice was studied through a multi-method triangulation: observation, interviews and daily journals. Verbal protocol from different sources led us to elicit 510 elements. Supported by Kelly's grid technique, matrixes of elements and constructs were proposed, which were then analyzed by factor and cluster analysis. The results have been described in two phases. In the first one, we analyze ten element networks and four constructs are applied to the data sources of three teachers, of Science, Mathematics and Language. In the second phase, the constructs and reflections-in-action of the three teachers in interactive teaching are described.

# I. INTRODUCTION

## 1. Objectives

This research project's fundamental purpose is to analyze teachers' thought processes in interactive class situations. In this project, we introduce research techniques which represent a considerable new turn in inquiry into teaching efficiency. Elementary and Middle School Teacher Training students, as well as students of the Philosophy and Science of Education may find, in this work, a new source of reflection on classroom interaction: from now on, our understanding of teaching action is better explained. To sum up, this study intends to:

1) Introduce a new paradigm of research in teaching.

2) Explain the actions of Elementary and Middle School teachers in the exercise of interactive class situations.

3) Propose teaching episodes for Spanish students of Elementary and Middle School Teacher Training and Philosophy and Science of Education.

## 2. Review of the Literature

### 2.1. Basic Asumptions of the Paradigm of Teacher Thinking

The factor that differentiates research on teacher thinking from other approaches is precisely the concern which exists to find out what reasoning processes occur in the teacher's mind during his professional activity. We assume, as fundamental precepts, that, in the first place, the teacher is a reflective, rational subject, who makes decisions, issues judgements, has beliefs, and generates his own routines within his professional development. Secondly, we accept that the teacher's thinking guides and orients his conduct (CLARK and YINGER, 1979; SHAVELSON and STERN, 1981).

These precepts have obviously led to the transformation of the concept held of teachers. Until now, the teacher was a technician (CLARK and LAMPERT, 1985) who had to master a more or less broad repertory of skills.

This conception of the teacher (and consequently of teaching in general) as a subject who builds and checks out his theory of reality moves away from positivist principles on the way to practice Science, and represents a qualitatively different approach. From this viewpoint, research on teacher thinking does not seek to issue generalizable laws about the phenomena it studies. The methodological precepts are different: the criteria of internal and external validity are exchanged for that of ecological validity . As GOOD and POWELL point out, the generalizations derived from this type of research "do not serve as predictions of future events, but rather as guidelines for understanding particular situations and contexts"(cited by CLARK and YINGER, 1980, pp. 4-5). Thus, research on teacher thinking also assumes some of the principles of methodological phenomenology, in the sense of inquiring into individual, unique and specific situations and problems (TESCH, 1984). From this perspective, the concept of individuality must not be taken as the only subject, but rather the individual unit of study may be a teacher, a class, a school, a community, etc.

## 2.2. Teachers' Interactive Thinking and Decision-Making

Interactive decisions, as opposed to planning decisions, are those which teachers make during their interaction with the students. There is a strong connection between the decisions teachers make when planning, and their class teaching. But now we are alluding to the fact that on many occasions during class teaching, situations are produced which may make the teacher modify his plans as he goes along; transforming them, shortening them, or adding new elements. This is one characteristic of interactive decisions with respect to planning decisions: the former must be made on-the-spot, and with a limited reaction time for the teacher.

Interactive decisions are produced as a consequence of a different operating situation from that which had been expected in planning, either for lack of student involvement, lack of attention, lack of discipline, etc. (SHAVELSON and STERN, 1981).

3. Research Plan

In this epigraph we summarize the major stages of the research project:

| | |
|---|---|
| I<br>DOCUMENTATION ..... | Procurement of documentation. Photocopies of articles and papers. |
| II<br>FORMATION OF THE RESEARCH TEAM ..... | Selection and training of researchers. Development of seminar and doctoral course. |
| III<br>DETERMINATION OF THE RESEARCH PROBLEM ..... | Analysis and summary of sources. Critical commentary of texts. |
| IV<br>SELECTION OF THE SAMPLE ..... | Convocation of teachers and observers. |
| V<br>DATA COLLECTION ..... | Use of observations, interviews, and daily journals. Sequention of the experience. |
| VI<br>SPECIFICATION OF ELEMENTS AND CONSTRUCTS ..... | Derivation of items for building the matrix. |
| VII<br>DATA ANALYSIS ..... | Factor analysis and analysis of grid clusters. |
| VIII<br>CASE STUDIES (PHASE II) ..... | Selection of three teachers and video-taping. |

## II. METHODOLOGY

### 1. Sample

The sample for this study is made up of a total of 21 teachers, 11 of whom (52.38%) are male and 10 (47.61%) female.

The average years of teaching experience is seven. The levels taught fall into the following distribution: sixth - eighth grades, 6 teachers (28.57%); third - fifth grades, 6 teachers (28.57%); first and second grades, 9 teachers (42.85%).

In general terms, the teachers have been working at the same school for two years. Of these teachers, 16 (76.19%) belong to public schools and 5 (23.80%) to private schools. 16 teachers (76.19%) work in schools in the capital city of Seville, while 5 (23.80%) work in schools in the rest of the province of Seville. As for their professional situations, 6 (28.58%) have permanent positions at their present jobs, 7 (33.33%) are temporarily working in this particular position, but have permanent employment in the Spanish system, and 8 (38.09%) have provisional contracts.

Within the last year, these teachers have attended an average of three courses or seminars on teacher improvement, with an approximate total duration of 13 hours. Only 0.6% have participated in experiences of educational research.

### 2. Data Collection Methods

#### 2.1. Participant Observation

The methodology of participant observation rests on the idea that the researcher becomes a member of the group and ends up adopting the group's perspective. At the same time as he participates, the researcher is also an observer, so that he can develop the realization of the traits that define the group from the group's own perspective. Thus, the act of observation becomes an "interactive act"; the researcher observes what goes on in class in interaction with its members "registering perceptible conduct in natural situations on the basis of a present outline" (FRIEDRICHS and LUDKE, 1975, p. 3).

Studies which use participant observation within the paradigm of teacher thinking are predominantly descriptive, and imply some kind of sociological or psycho-sociological analysis. These studies show the teacher and the contextual variables as crucial elements in the teaching process.

## 2.2. The Interview

The interview facilitates the discovery of the meaning that remains implicit in teacher thinking, allowing us to understand teachers' conceptions of reality and sense, and the significance they assign to their actions. To understand other people's conceptions of reality, the best thing we could do -- according to JONES (1985) -- is to ask them, and ask them in such a way as to make them able to talk to us with their level of depth that seeks the rich context which is the essence of their meanings.

ELBAZ and others (1985), working with teachers in training, with teachers in their classes and with students, used semi-structured clinical interviews to find out what the conceptions are, in each teacher's program, of the fundamental and auxiliary subject matter, as well as these teachers' experience in their actual teaching practice, and the social context of their teaching.

## 2.3. The Daily Journal: Personal Documents For Studying Teacher Thinking

We can consider the written daily journal as a kind of "thinking-out-loud" on paper, as we use it to obtain a written report of what teachers think about during the planning process.

The function of writing is not only a form of expression, but the nature of the cognitive process involved makes the act of writing a very effective way of learning.

## 3. Research Procedure

Elementary and Middle School teachers in practice filled out class journals at the rate of one sheet per day for seven weeks.

The observers visited the teachers during seven weeks, taking field notes in class, later performing interviews which were taped on cassettes.

The 700 pages of documentation from observation protocols and transcriptions of interviews, as well as the 595 journal sheets made up the sources which were used to specify the 510 elements which summarize teachers' interactive actions.

In order to derive constructs, teacher-observer couples were established, who interviewed each other.

## 4. Analysis Techniques

### 4.1. The Personal Construct Theory

The study of teachers' reflections-in-action was carried out within the framework of KELLY's grid theory of research. Studying teacher thinking means analyzing the teachers' constructs and the ways in which they are related. This line of research has been widely followed and accepted, in spite of criticism, by researchers in the field of teacher thinking (YORKE, 1985). The literature shows a broad repertory of studies along this line. Thus, POPE studied the perceptions on teaching of students in practice; PERROT analyzed changes in teacher judgement after participation in improvement courses, and a group of researchers -- BELL; ROLPH and ROLPH; PARSONS, etc. -- used the grid to examine, in greater detail, individual teachers' systems of beliefs (cited in YORKE, 1985).

As FRANSELLA and BANNISTER (1977) point out, there are seven varieties in the use of grids. Most authors have selected the triads, in the nature of the "original form of the grid," which consists of asking the subject whether two of the three elements bear any resemblance to each other that would distinguish them from the third. Then the subject is asked to give a name or classification (construct) to the differentiating trait. The opposite of this characteristic is contrast. Although manual procedures could be used to represent thinking, computer programs are usually put into practice. POPE and KEEN (1981) show methods of analyzing the data, indicating that factor and cluster analysis are the most widespread.

In our study, the elements were specified in such a way that a subject, either teacher or observer, could derive 15 valid statements of actions (elements) which were representative of the sources (journals, observation and interviews). The elements were supposed to transcribe or paraphrase episodes or segments of events, interactions, thoughts, feelings, decisions which had already been reflected.

The constructs were derived through the triad procedure. Each interviewer gave his interviewee three cards which were to be grouped into two very similar ones, setting aside the third one as representing the opposite. By way of a small semantic differential, made up of opposite (antonym) pairs of actions (adjectives, nouns), a variable number of constructs were developed for each subject.

## 4.2. Analysis of Grid Data

Once the grids were completed, the next step in our research was interpreting the information collected on them. To this end, we developed a few analysis procedures that helped us measure the type of associations among the constructs and among the elements. The two main methods used were factor and cluster analysis (BEAIL, 1983).

### 4.2.1. Factor Analysis

The first application of factor analysis to grid studies was developed by KELLY (1955). This author designed a method of particular traits to apply it to already classified score matrices. It was a non-parametric method that permitted even manual grid analysis.

But, along with the programs of the SPSS statistical package, other methods have been applied for factor grid analysis by computer. MUNBY (1982) used the PRYME method, which includes factor analysis and analysis of the principal components in varimax rotation (VELDMAN, 1978), with the purpose of checking a teacher's beliefs and principles on educational planning, grouping his sentences and statements by factors.

In our country, also within studies on teacher thinking, ESCUDERO MUÑOZ and GONZALEZ GONZALEZ (1985) applied BMD statistical package program P4D to data gathered on a grid, about teacher reactions to the implementation of innovating curricula in Elementary Education ( Renovated Programs for 3rd - 5th Grades). This same statistical procedure has been applied to the data in our research.

With the grids introduced in the computer, from print-outs that collected matrixes from scores for 12 constructs as functions of 15 elements and vice-versa, program BMD P4D was used to separately calculate the factor analysis of the constructs and elements identified by the teachers and observers in the project. In our study the factor matrix disregarded "weight" or "saturation" under 0.250.

Each one of these grids constituted a matrix made up of 180 digits, each of which varied on a seven-point scale, with the numbers 1-7 corresponding to the value of the 12 opposing constructs extracted in an earlier phase of the study, as a function of the 15 elements obtained from the interviews, observations and teachers' daily journals.

Our objective was to extract a sufficient number of factors to explain the variance which exists between the scores registered by the 32 grids for each one of the 12 constructs considered.

As we can see from Table No. 1, after varimax rotation, the 12 constructs are explained in four factors. Factor 1 shows the highest percentage of variance (VP 2.513), and Factor 4, the lowest (VP 1.464).

In Factor 1, the constructs with the greatest weight or saturation are those of "Use of Resources" (7/ .81) and "Use of Ideas" (6/ .74). In Factor 2, the constructs of greater weight are "Practice" (11/ .88) and "Activity" (4/ .64). Factor 3 shows a greater saturation for the constructs "Directivity" (5/ .78) and "Programming" (2/ .64). Finally, Factor 4 presents greater weight on the constructs "Socialization" (1/ .80) and "Multidirectional Communication" (12/ .75).

TABLE No. 1

| CONSTRUCTS | FACTOR 1 | FACTOR 2 | FACTOR 3 | FACTOR 4 |
|---|---|---|---|---|
| 7. Use of Resources | 0.815 | | | |
| 6. Use of Ideas | 0.744 | | | |
| 8. Motivation | 0.659 | | | |
| 10. Creativity | 0.603 | | | |
| 11. Practice | | 0.883 | | |
| 4. Activity | | 0.646 | | |
| 5. Directivity | | | 0.786 | |
| 2. Programming | | | 0.637 | |
| 3. Rigidity | | | 0.624 | |
| 1. Socialization | | | | 0.803 |
| 12. Multidirectional Communication | | | | -0.746 |
| VP. | 2.513 | 1.767 | 1.733 | 1.464 |

Table No. 1: Rotated factor matrix of the analysis of constructs.

Program 4M , of the BMDP package, was also applied to the factor analysis of the grid elements. In order to do this, we designed a program that literally rotated the space occupied by the constructs, allowing the elements to act as variables. Thus, the 32 former grids now gathered a distribution of scores as a function of the 15 elements extracted from each teacher's statements.

TABLE No. 2

| ELEMENTS | FACTOR 1 | FACTOR 2 | FACTOR 3 |
|---|---|---|---|
| 2 | 0.737 | | |
| 4 | 0.653 | | |
| 7 | 0.558 | | |
| 1 | 0.508 | | |
| 9 | 0.506 | | |
| 10 | | 0.737 | |
| 14 | | 0.563 | |
| 15 | 0.509 | 0.559 | |
| 3 | | 0.558 | |
| 11 | | | 0.722 |
| 6 | | | 0.707 |
| 8 | | | 0.472 |
| VP. | 2.531 | 2.070 | 1.928 |

Table No. 2: Rotated factor matrix of the analysis of elements.

Table No. 2 collects the weights or saturations for the 15 elements according to three factors. Factor 1, which explains a greater variance (VP 2.531) follows elements 2 (.74), 4 (.65), 7 (.56), 1 (.51), 9 (.51) and 15 (.51), whose greater weight falls on Factor 2, which explains a lower percentage of variance (VP 2.070), and where elements 10 (.74), 14 (.56), 15 (.60), and 3 (.60) have the greatest saturation. In Factor 3, which explains the lowest percentage of variance (VP 1.928), elements 11 (.72), 6 (.71) and 8 (.47) are those of greatest weight.

4.2.2. Cluster Analysis

In this research project, cluster analysis was applied to discover a "cluster" or bunch structure adjustable to the data gathered on the grids.

Cluster analysis has adapted itself well to the requirements of grid studies. As early as 1965, BANNISTER proposed a simple method of cluster analysis, the "Anchor Method" which managed to derive a bidimensional representation of the grid. To achieve this, the construct with the highest correlation with respect to the others was taken and placed on a first axis. The second highest construct was placed on a second axis. The rest of the constructs were traced in relation to these two axes, using their scores as coordinates.

In our research, the clusters or bunches were obtained by applying a series BMDP prototype statistical package; specifically, program 1M of the multivariant analysis programs.

The minimum distance method is based on the idea that each individual is a separate "cluster". It begins by calculating the distance between each pair of individuals (elements or constructs) and then goes on to join one individual to a cluster or one cluster to another, depending on the criterion of the shortest distance between the nearest individuals, each of them belonging to separate clusters.

The analysis of constructs through the clustering method would allow us to test the validity of factor hypotheses with respect to the distribution, by factors, of the constructs elicited in our research . Along these lines, the clusters formed were supposed to approximate the closest constructs and prove that they were similar to the previously extracted factors.

The fusion or link of the shortest distance of all the construct pairs has the value of 63.81, and corresponds to the constructs "Motivation and "Creativity" (8-10). We join this cluster to the construct "Activity", at a distance of 55.95 (8-10-4), which in turn links with the construct "Use of Ideas" (8-10-4-6), at a distance of 51.40. Finally, the construct "Use of Resources" is joined to the previous bunch (8-10-4--6-7), at a distance of 46.14. This is the main cluster, in which constructs (8-10-4) stand out as being most similar to one another.

A second cluster is made up of the constructs "Rigidity" and "Directivity" (3-5), joined to each other by the value of 42.24.

The third cluster is formed through the union of the construct "Practice" with the first bunch (8-10-4-6-7-11) at a distance of 39.96, and associating this new cluster with the construct "Dialogue". Thus, one great cluster, or bunch, arises, made up of all these constructs: (8-10-4-6-7-11-3-5-9).

The last cluster we considered is composed of the constructs "Socialization" and "Unidirectional Communication" (12-1), joined at a distance of 29.89.

In order to decide the number of clusters in this dendogram, and as this problem has yet to be solved satisfactorily by specialists, (EVERITT, 1980), we adopted a heuristic criterion: considering the greatest numerical difference in the values which represent the amalgamation

distance in the face of two variables or constructs. In this case, the most important distance between two clusters was located betweeen the values 19.78 and 28.48, which reflected, respectively, the amalgamation differences between tne constructs "Socialization" and "Programming" (1-2) with respect to the rest of the groups of constructs, or clusters obtained.

Table No. 3 shows an interpretation of the dendogram according to the construct groupings.

TABLE No. 3

| | Constructs | Amalgamation Distance |
|---|---|---|
| | MOTIVATION-CREATIVITY | 63.81 |
| Cluster | MOTIVATION-CREATIVITY-ACTIVITY | 55.95 |
| 1 | MOTIV.-CREATIV.-ACTIVITY-USE OF IDEAS | 51.40 |
| | MOTIV.-CREATIV.-ACTIV.-USE OF IDEAS-USE OF RESOURCES | 46.14 |
| Cluster 2 | RIGIDITY-DIRECTIVITY | 42.24 |
| | ACTIVITY-USE OF IDEAS-USE OF RESOURCES-PRACTICE | 39.96 |
| Cluster | ACTIV.-IDEAS-RESOURCES-PRACTICE-RIGIDITY-DIRECTIVITY | 37.13 |
| 3 | MOT.-CREAT.-ACT.-IDEAS-RES.-PRAC.-RIG.-DIR.-DIALOGUE | 35.38 |
| Cluster 4 | SOCIALIZATION-UNIDIRECTIONAL COMMUNICATION | 29.89 |

Table No. 3: Construct groupings resulting from cluster analysis.

For the cluster analysis of the elements, we again used program 1M of the BMDP statistical package.

From this dendogram, four clusters are especially distinguishable. The first one is made up of elements 2-4 (36.82), to which we join the pair 1-9 (33.89) at a distance of 33.45. The cluster is completed with elements 5 and 7, linked to the rest of the bunch at distances of 33.45 and 32.01, respectively. Thus, in the first cluster elements 2-4-1-9-5-7 of each grid are associated among each other.

The second cluster is produced out of the union of elements 13 and 15 (33.51) with element 12, at a distance of 33.11.

A third cluster groups three elements of the grid. The third element, 11 at a distance of 31.22 joins onto the initial bond (6-8).

The last cluster we have assumed groups two elements with each other (3-10) at a distance of 30.35. From this distance on, under the heuristic prerequisite that we would not take into account any new elements or clusters if they were to make a great difference between two given values or distances, we have included no more clusters nor elements (See Table No. 4).

TABLE No. 4

| | Constructs | Amalgamation Distance |
|---|---|---|
| | (2-4) | 36.82 |
| | (1-9) | 33.89 |
| Cluster | (2-4-1-9) | 33.45 |
| 1 | (2-4-1-9-5) | 33.45 |
| | (2-4-1-9-5-7) | 32.01 |
| Cluster | (13-15) | 33.51 |
| 2 | (13-15-12) | 33.11 |
| Cluster 4 | (3-10) | 30.35 |

Table No. 4: Element groupings resulting from cluster analysis.

### 4.2.3. Interpretation of the Correspondence Between Factor and Cluster Analysis Results

Comparing the results of both analyses, as shown in Table No. 5, it is possible to infer similarities between Factor 1 and the first cluster with respect to the constructs "Use of Resources", "Use of Ideas", "Motivation" and "Creativity" (6-7-8-10). A similar inference can be made between Factor 2 and the third cluster, except that here, the only common constructs are "Activity" and "Practice" (11-4). We may also relate Factor 3 to the second cluster for the constructs "Directivity" and "Rigidity". Finally, if we compare Factor 4 with the fourth cluster, two common constructs are obtainable: "Socialization" and "Multidirectional Communication" (1-12)

TABLE No. 5

| Factors | Common Constructs | Clusters |
|---|---|---|
| 1 | MOTIVATION<br>CREATIVITY<br>USE OF IDEAS<br>USE OF RESOURCES | 1 |
| 2 | ACTIVITY<br>PRACTICE | 3 |
| 3 | RIGIDITY<br>DIRECTIVITY | 2 |
| 4 | SOCIALIZATION<br>MULTIDIRECTIONAL COMMUNICATION | 4 |

Table No. 5: Correspondence between factor and cluster analysis of constructs.

So, in the first group, we decided to reduce the analyzed information around the construct"MOTIVATION-CREATIVITY", while in the second - group we considered that teachers' interactive decisions could be grouped around the construct "ACTIVITY". We understood that the third group included concepts related to DIRECTION, while the last group of constructs on which the teachers in our study based their instructional decisions, during the interactive phase of their teaching, revolved around motivation and creativity, activity, direction and interaction.

### 4.2.3.1. Correspondence Between Factor and Cluster Analysis of the Elements

Establishing a correspondence between both groups of values, such as that carried out in Table No. 6, we can infer common elements that validate the factor construction. Thus, in Factor 1 and in the first cluster, the common elements are those identified with digits 2, 4, 1, and 9; in Factor 2 and the fourth cluster they are 3 and 10, and finally, in Factor 3 and the third cluster, the common elements on all the grids are 6, 8 and 11.

TABLE No. 6

| Factors | Common Elements | Clusters |
|---|---|---|
| 1 | ((2-4-7-1-9)) | 1 |
| 2 | ((3-10)) | 4 |
| 3 | ((6-8-11)) | 3 |

Table No. 6: Correspondence between factor and cluster analysis of elements.

## III. RESULTS

### 1. Findings

### 1.1. First Phase: General Description of Interactive Teaching Through Interpretative Research

#### 1.1.1. Introduction to Data Reduction Techniques

Once we carried out the factor and cluster analyses, we could obtain ten elements which grouped the set of elements elicited by the observers/interviewers and teachers in each one. Each element set consisted of 34 sentences, statements or elements.

At this point, we needed to adequately and understandably represent each of the ten element sets obtained. We considered that ties, bonds or networks could be a valid form of representing the set's elements. In this sense, our elements could conceptually equal the empirical assertions as ERICKSON (1986, pp. 146-7) uses them. We looked for what he called "key ties" between the different data items, which in our case were the elements. So a key tie is defined by having a central meaning for the elements of the set. We consider that the elements were assertions proceeding from different bodies of data : from field notes made by observers, interviews also make by observers, and daily journals written by the teachers.

Along these lines BLISS, MONK and OGBORN's work (1983) is a methodological resource for elaborating systematic networks, which are procedures of joining categories.

The question is whether a network can synthesize what happens in the different element groupings that symbolize a sample of teachers' teaching. We have observed that the particular structures had accompanying traits and notes (terms and categories) that differentiated them. The final structure or general outline was the result of applying categories which were reiterated in the particular outlines. Yet, incidence was not the synthesizing prerequisite. We pondered the meaning of the key tie for its identification and application to future performance. So we associate the verbal data proceeding from short term memory (journals and interviews), as ERICSSON and SIMON tell us (1980), with other manifestations of behavior , such as the teacher's performance in class.

Our classification had different coding and counting problems. The representation of the categories (irreducible terms of the elements) and the explicit order we propose neither symbolizes a chronological structure nor a causal connection (although such causality might exist). Nor have we intended to represent each and every element in the structure. We have kept in mind one of the specific elements of our study: to look for types of reflections made by teachers. So we have paid more attention to what goes into reflections-in-action carried out by teachers. We wanted to find out the possible reflections-in-action which teachers make, based not so much on the observations, as on the interviews and the journals, whenever there was evidence of a teacher speaking in the first person, explaining and making the reflections explicit. As a priority, we classified "reflection-in-action" and "on-action". (SHÖN, 1983, p. 55).

### 1.1.2. Hierarchy of Elements: From a Particular Description to a General One

Element No. 2: When it came to ordering and classifying elements that make reference to teachers' reflections, we agreed upon several categories for denominating functions, activities and attitudes. Teacher functions make up the hierarchy with the most developed subsidiary ties. Thus, the function of orientation or advice appears, in the above-stated terms, as follows:

> No. 227. "I advise and orient a working group, in order to make their activity dynamic."

Teaching functions have allowed us to elicit some aspects of instructional theories. Most reflections have to do with instruction.

One function that reasonably represents a mode, or even a system of education, is individualization. This student-centered orientation -- in search or participation through activities which favor a better understanding -- is what we call the function of human relationships.

We can characterize individual and group activities which tend to favor student success.

Element No. 4: This refers to methodological aspects. Most of the elements center their attention around what teachers do to transmit information. The elements form bunches or clusters in the category of teaching methods, classified into "active" or "traditional" practices. In the former, teachers pay attention to students' tasks, concerned that

students be able to express themselves. With the term "traditional" we mean to indicate that the teacher uses his authority, calling the class' attention to maintain order.

Reflections appearing in this element set are limited. Because of the occurrence of element categories, it is possible to state that in active methods, there exists a certain sensitivity to foster dialogue and expression with the students, as indicated in elements 244,4,394, 94, 439 and 454.

In this element set, we perceive examples of certain teaching practices becoming routine ("Math class always begins by reviewing multiplication tables", item 274).

Element No. 7: This can be characterized by a diversification in teachers' reflections in-action and on-action; reflections about aspects of preinteractive teaching or planning. The objectives teachers try to achieve in students chiefly refer to creativity.

The rhythm or pace sets the instructional tempo, and together with the activities, make up a block of thought on interactive teaching.

Evaluation also warranted a certain amount of reflection on the part of the teachers, about the results of the group experience, which evidenced the teacher's disposition towards a personalized educational pattern.

However, what gives this element set a certain originality is the reflections on the teaching profession itself. In fact, items 472 and 502 are concerns which to a large extent characterize the beginning teacher:

> 472. The biggest problem facing me as a teacher is the lack of knowledge we have of everything. We do not know how to teach.

Element No. 1: The three dominant categories are motivation, activities and relationships. As for motivation, teachers' references have to do with the student they motivate (item 136: I encourage those children who are slower to learn, more than the others), and the area of knowledge they have selected (Language). They motivate students as much in reading (item 181) as in writing (item 496).

Activities are classified as being free (students feel free doing them) or as being adapted to the students' level of development. It is noticeable that when teachers voice their thinking, they show a student-

oriented teaching style. This statement is evidenced and reiterated in the following category that we identified: we establish relationships.

Motivation is accomplished with humor and through positive reinforcement, constantly, and attempts to make the instructional process pleasant.

Element No. 9: This element set is dominated by the student's presence and protagonism, so the categories which have come out of the elements make us see that in a type of teaching such as that reflected in this set programming is done justifying it to the students, and therefore the teacher reflects on how the program should be designed.

In this element set, the students are the main protagonists. The teacher not only accepts suggestions for programming activities, but also the students' feelings (item 294), which does not mean that the teacher is not upset by students who inhibit their classmates' study, (item 369) while they do have permission to freely move about the classroom (item 99).

Element No. 3: Aspects belonging to the category of activity predominate in this element set. The word activity clearly does not exclude others we have identified to form a hierarchy of the set of elements. Everything about which a teacher reflects-in-action refers to activities or participation.

For student participation in class, he selects the participants on the basis of psychological characteristics (I give priority to participation by shy students, item 108). There is also group participation, especially when certain types of routines are to be maintained. "I propose a Math activity but they all want to keep working in their group books" (item 228).

Element No. 10: We have observed that the teacher only reflects-on-action in six statements. The reflections correspond to categorizations established for this element set. Thus, there is a first category we have agreed to call creativity, already proposed for other element sets.

We situate the first reflection under the category of creativity: "I could see the difficulties of doing some kind of creative activity with unaccustomed students when I suggested making rhymes with the kids in class 1-A. I could also share the gratifying part of the creative result with them." (item 190). We observed that to develop creativity,

specific techniques are shown, which are difficult and gratifying. So concepts such as motivation, activity and creativity are closely related, and in them there is a principle of causality, or at least of inclusion or belonging.

Element No. 6: The elements in this set may be classified by establishing a relationship with the students so that they assume responsibility, and the teacher is conscious of the students' difficulties and recognizes that he should pay more attention to them. In the class, when situations arise in which the students feel or appear aggressive, the teacher distinguishes the problem in terms of the number of trouble-makers, giving individual or group solutions, and he maintains and facilitates relationships through questioning.

There can be academic pressure, for the need of covering the entire instructional program as designed (item 456), which makes teachers control students rigorously: "Many times I don't think about it. I just say, 'We are too demanding.' I often want them sitting down; I frequently want them to be quiet, but they can't do that. The thing is, you always have a program behind you. You always have something that forces you to go one way or another."

Another large category is motivation. Motivation is positive, it helps initiate activities or tasks, and is supported by particular theories on learning, relative to a certain curricular area.

Element No. 8: Teachers' reflections are centered on two categories: instruction and relationships. In the former, teachers' objectives are to reiterate concepts or review subject matter. The teacher promotes the manipulation of materials to carry out instructional activities.

The network of relationships is more congruous, showing a high degree of "belonging". In this category, the element of acceptance of ideas is reitereted, evidencing another characteristic of indirect teaching, and consequently, what comes out is a theory-in-use, on a conception held by FLANDERS of teaching.

The category with the greatest concentration of elements is that which sees the teacher as an instrument of dialogue.

Element No. 11: This is made up of six or seven reflections belonging to categories we have labeled planning, management, explanation and motivation. As for the category of planning, the teacher makes decisions, which are democratic in character, or at least this is how they are indicated in items 116 and 296, which say, respectively: "I submit some matters to democratic class decision " and "I am democratic."

In the category of explanation, the teacher attends to students who have learning difficulties.

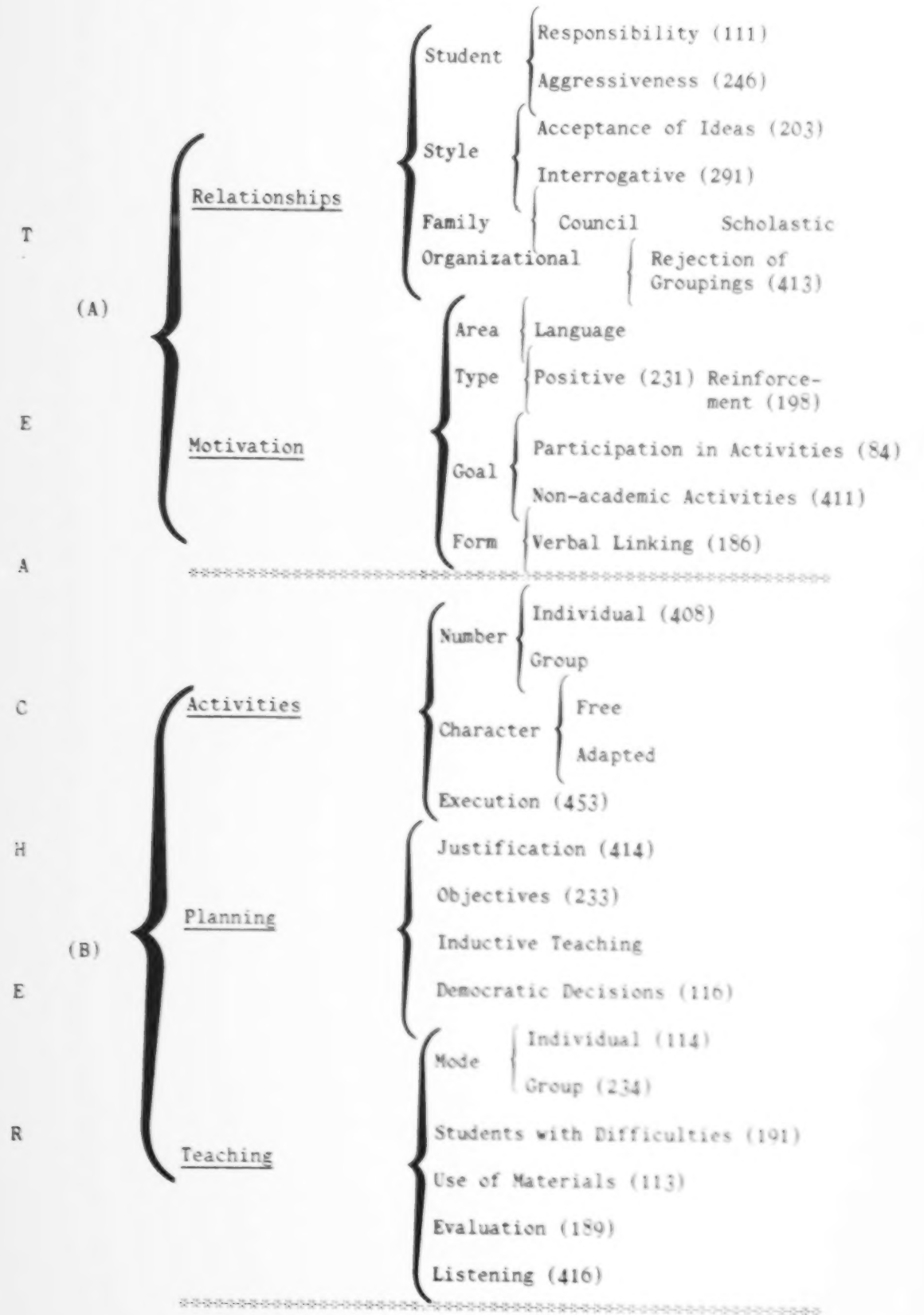
The rest of the elements can be classified under the heading of organization of class instruction. Here we would like to call attention to certain class practices that seem to be routine. For example, item 461: "At the beginning of the class (the teacher) talks to the students. It is a sort of assembly where they have to ask permission to speak, and be quiet when others are speaking. It is, in fact, oral language training... (the teacher) tries to have them respect one another and listen while others talk...".

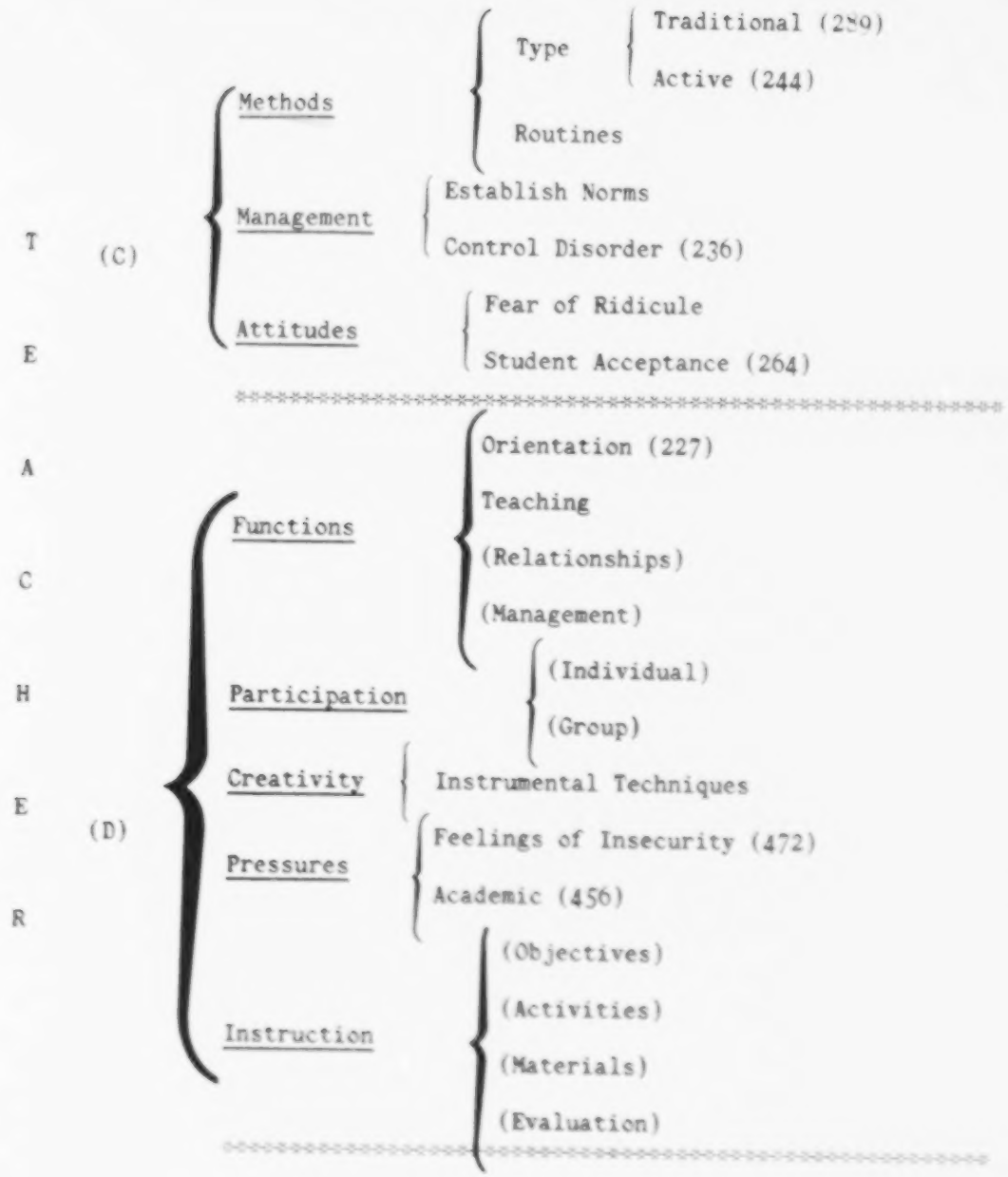
The category of methods includes diverse elements. Our attention is called to statement 176 because it assumes a theoretical principle: "Psychomotor skill is a prior basis for acquiring scholastic concepts", which comes from a transcription of an interview held with a teacher.

## Proposal of a General Outline Based on the Reflections Elicited in the Ten Element Sets Above

The purpose of drawing up a general outline is that it can give a synoptic view of the particular descriptions we have made on the basis of each of the elements. Figure No. 1 is an outline-type representation, or map of the partial networks according to the frequency of each "opening category" (those categories which opened up a range of items) within the network. We have scaled the categories to indicate the frequency of reflections on each one. The higher categories (A and B) are those which were most often reiterated in the particular outlines. The lower level categories (C and D) also have reflections that had already been classified, which is why they appear in parentheses.

FIGURE No. 1


T
E
A
C
H
E
R
(A)
(B)
Relationships
Motivation
Activities
Planning
Teaching
Student
Responsibility (111)
Aggressiveness (246)
Style
Acceptance of Ideas (203)
Interrogative (291)
Family
Council
Scholastic
Organizational
Rejection of Groupings (413)
Area
Language
Type
Positive (231)
Reinforcement (198)
Goal
Participation in Activities (84)
Non-academic Activities (411)
Form
Verbal Linking (186)
Number
Individual (408)
Group
Character
Free
Adapted
Execution (453)
Justification (414)
Objectives (233)
Inductive Teaching
Democratic Decisions (116)
Mode
Individual (114)
Group (234)
Students with Difficulties (191)
Use of Materials (113)
Evaluation (189)
Listening (416)


TEACHER
(C)
Methods
Type
Traditional (289)
Active (244)
Routines
Management
Establish Norms
Control Disorder (236)
Attitudes
Fear of Ridicule
Student Acceptance (264)
(D)
Functions
Orientation (227)
Teaching
(Relationships)
(Management)
Participation
(Individual)
(Group)
Creativity
Instrumental Techniques
Pressures
Feelings of Insecurity (472)
Academic (456)
Instruction
(Objectives)
(Activities)
(Materials)
(Evaluation)

## 1.2. Interpretative Commentary on Interactive Teaching : Second Phase

### 1.2.1. Microethnography Applied to Three Classes

The approach we have selected is on interactive class teaching. Consequently, we have paid attention to teachers' actions in class, and in order to analyze their teaching, we video-taped six lessons each, on the areas of Science, Mathematics and Language.

The scientific approximation we have followed for these 18 video-recorded lessons is called "microethnography" (ERICKSON, 1986). This expression is similar to those of "constituent ethnography" or "socio-linguistic microanalysis." In the analysis work on the videotaped lessons, the observer is not dominated by the sequence, multidimensionality, immediacy and simultaneity of class occurrences within a given time frame.

The methodological limitation ERICKSON points out, that the analysis loses the sense of context, was not the case with us, because the teachers read the descriptions we made of them and we clarified details where necessary, in some of the affirmations that went into the commentaries.

Constructs are abstract categories supported by empirical assertions. In fact, they go to make up the units of analysis on the teachers: we try to reconstruct the professional framework of the teacher, taking, as a reference, a finite number of constructs to offer three narrative vignettes (ERICKSON, 1986, pp. 149-51). These vignettes have the objective of showing the meaning of these teachers' lives, supported, for this purpose, by analytical concepts that act separately. Besides, the vignette will show evidence to illustrate, to the reader, that the analysis of the facts is valid. The vignette is an abstraction, or caricature of the events, based on quotations. The paragraphs come from sources obtained on different days, that can guarantee the possible generality within the body of data on each teacher. In short, we aim to theorize on the particular notes or data.

In studying teachers' reflections in interactive teaching, we indirectly describe how life is organized inside the classrooms, which is the interest of ecological psychology (DOYLE, 1986).

### 1.2.2. Three Teachers' Reflections-In-Action

In this section of the study, we wanted to identify reflections-in-action and on-action by teachers in their interactive teaching.

There are not many research examples in which SHöN's principles of the paradigm of reflection-in-action have been put into practice. One of them is the Canadian RUSSEL's work (1986), in which he aims to identify those periods when a student in training, in conversation with his teacher-tutor, tries to establish problematical situations and reflect on controversial moments in the teaching situation.

MACKINNON (1986) sought to demonstrate the link between SHöN's theoretical perspective and what happened in Methods students' clinical supervision.

Finally, KILBOURN (1986) (also from Canada, like the previous two researchers) investigated Science teaching to 8th - 10th graders. The data were analyzed according to outlines or particular configurations. Thus, he paid attention to the nature of interactions within the classes. The framework of the case selected was taken in terms of the teacher's desire to involve the students in a conversation characterized by reasoning, argumentation and explanations.

Teacher M. T. R. (Science)

Motivation-Creativity.-- In a sixth grade class, he motivates students through emulation. In his Science class, he induces students to be inquisitive, as scientists are, in order to perform discoveries, based on the manipulation of objects and analytical inferences.

Science teaching begins with experience of reality or of objects. Students perceive, through their senses, what things are, and from this point on, they can abstract or generalize principles which govern the behavior of phenomena.

Finally, in his Science class, he also develops the imagination by means of images: "To imagine it, we could see it like a river."

Activity.-- Some activities are supported by those set out by the textbook authors. The textbook serves as a basis for reading activities ("Take out your books, and let's read what the book says about batteries"), or for doing exercises ("Now let's take the book and finish the last question left, the one on batteries").

Another block of time in the class session is devoted to the correction of previously assigned exercises. These are corrected by fellow students. With this practice, we note degrees of socialization in his teaching, as a motivational and instructional strategy.

In class, the students usually do brief exercises to test their understanding, where they fill out exercise sheets. The type of exercise is that of application of the knowledge acquired.

The evaluation procedure is formalized and adopts certain routines. The identification of subjects and the creation of a climate of expectation, with silence before enunciating the questions, are noticeable. We observe that tests are a procedure for keeping order, in the light of the attention aroused.

In his class, students work at their desks ("Copy that there, because later you'll need it to do the activity "), emphasizing that they are personal matters, or individualized tasks.

Direction.-- M. T. R.'s management is primarily in the area of keeping order in class. In this aspect he is thorough, imposing his authority so that the students fulfill the requirement of being seated with orderly conduct. ("I don't want to see people the way I saw Carretero when I walked in.") Orders are cut and dried:

> "I don't want absolutely anybody here! Whoever has to get something, or tell me something, sit down. Save your comments and tell me at the end of the class."

M. T. R.'s management also includes the development of certain working techniques, such as underlining, note taking, etc.-- with which activities are led.

M. T. R. is concerned with time as a unit for carrying out tasks. It is an important variable in a type of instruction oriented towards reciting-questioning-testing in class, and application outside of class.

In his management of the class, he knows when to do the activities. He has an outline of the planning which he transmits to the children so that they may be aware of events or future outlooks.

He is meticulous in matters relating to evaluation. He marks those aspects or topics which are objects of evaluation , in detail , which demands a minute control over his students' class performance. Finally, he demands responsibility of them. This is evident in the extra-study assignments for defficient students.

Interaction.-- We may say that M. T. R.'s class teaching is interactive, and that this interaction is provoked by questioning. This interrogation is the instructional function that could best characterize M. T. R.'s teaching behavior. We have classified his questions under the categories Type and Function. Under the first heading, we understand those matters aimed at eliciting levels of thinking from the students, and which are therefore susceptible to ranking in a taxonomy.

Inquiry or discovery takes place by means of the tool of interrogation. The teacher directs the discovery.

This inquiry is a form of inducement that the students also exercise in class. Most of the questions are rhetorical, in that they seek clarification of an instructional procedure.

Reflections.-- These refer to instructional and class management problems. First, we observe that time is a problem for developing certain concepts. In Science teaching, the teacher sometimes states that his philosophy is based on inquiry, which is a slow procedure, and one of constant interaction with his students.

The teacher gives pedagogical reasons that help us to understand how learning may be produced: "Some remember the little examples; the little things given with what they really are; with the real descriptions of things." The reasons may also be managerial, produced as a consequence of the number of students in a class.

Teacher A. A. O. (Mathematics)

Motivation-Creativity.-- The teacher reduces the complexity of Math teaching by means of expresssions which relieve the tension of a subject in which reasoning is established through symbols.

Students are also motivated in feedback . Positive reinforcement, through expressions that rate the students' performance in accordance with what is expected, comes out in the form of statements such as "Very good!".

Activity.-- Problems may give rise to individual or group tasks, and in the latter, the teacher can be directly involved.

In his class recitation, brief interaction is used so that the teacher continues the sequence of explanation, resting momentarily on the student's answer.

Exercises tend to take up about eleven minutes of the 50 total that each period lasts. While they are involved in the exercises, students usually behave noisily, or at least whisper.

The purpose of the exercises is to apply knowledge they already possess. Students also come up to the board to perform demonstrations.

Class time can be made up of these two movements: exercise correction and recitation or explanation of concepts, principles or formulas. The time devoted to explanation is variable, though he points out which concepts or matters of concentration will occupy the time of his explanation.

Direction.-- In the class, he always marks the beginning or change of activity with expressions that mean the whole class must move to a signal he establishes.

He also indicates the moment of correction ("Now let's correct what you had") with which he alludes to a sequence whereby they do exercises and correct them during concrete periods, normally initiated by the teacher.

The immediate planning of his classes may consist of pointing out which problems (generally from books) are for homework.

Exercises, when carried out in class, are usually done gradually, starting with the simplest ones, and, as always, he signals how and when to change activities.

In his classes he constantly gives cognitive directions on instructional aspects, pointing out what should and should not be done: "Yes, these four of these, and these two of these two. Put them -- classify them first. Classify them now first as we have seen here, and represent them, OK?"

The teacher generally summarizes the explanations to check learning.

Interaction.-- As we could perceive in describing the three previous constructs, the teacher maintains a structure of class communication in which movements leading to lesson organization predominate. In his interction with the students, he appears to be seeking the immediacy of their answers, and with them he closes the cycle of communication: brief, concrete question; the answer, sometimes monosyllabic; and afterwards, evaluation of the answer.

Reflections: Most of them have to do with designing the instruction; design in terms of the chronology of mathematical contents and sequencing. His constant concern is to mark what is unknown for the students, and when they are going to learn it. He also points out the complexity of the segment of subject matter they have to learn.

Another of the reflections has to do with one of the goals of Mathematics, and alludes to one of this teacher's theories-in-use, whereby he generates actions designed to be in line with such a theory. In fact , Mathematics should be a curricular area that promotes abstract reasoning.

The teacher sets out what material is to be learned and what is not, because his effort as a Math teaching professional is that this subject does not constitute a difficult and unsurmountable content. Students must deduce, and in other cases memorize routines or algorithms.

There are frequent allusions to analogous procedures which facilitate solutions to the problems. His reflections serve to evoke, in students' memories, earlier learning to which new concepts must be connected. The teacher is to some extent concerned with the logical organization of the subject matter.

Teacher A. C. G. (Language)

Motivation-Creativity:-- The teacher motivates through verbal expressions in his Language classes, which include positive reinforcement. The reinforcement usually comes after exercises:

> "That's good, very good.... You should try not to repeat...so you have solved it all very well... Perfect... "

Reinforcement takes on the nature of acceptance of the students' ideas, which can give rise to the probability that indirect teaching will take place.

Motivation in the area of Language is developed by means of simulation games. It is not unusual for a Language class to carry out representations on communication through the radio.

Activity:-- The teacher constantly alludes to the performance of activities which constitute the motive for class interaction. Communication is a transaction of information with instructional purposes:

> "Because the idea is for you to do a series of activities with the object of improving certain aspects of Language, and also to have a good time, which is important, too."

The activity is a form of student involvement in instructional tasks. Therefore, in his class, students have to intervene, suggesting ideas, counting and describing concepts, or classifying and paraphrasing terms or narrations.

The instructional activity not only happens at the student's desk, but students are also called individually to the board to develop some of the exercises proposed, or to review previously exposed material.

In his class, exercises are assigned from the textbook. Sometimes the activity is collective, and all the students must perform the task indicated on a specific page. Then he has one student read, and afterwards, insists on the norms that govern the performance of the activity. His concern, thus, is to consult the class if there are doubts, clarify norms, and if everything is satisfactory, he decides to pass on to another of the proposed activities.

Direction.--In the class, he requires students' attention to introduce topics or exercises. Therefore, he establishes the conditions of communication.

Reading as an activity in this subject takes on a special interest. It is not surprising that specific reading skills are taught in this class.

He is conscious that the task is supposed to produce learning in the students. Thus, in his orientation to them, we find some principles which govern learning, and which he makes explicit.

In his classes, evaluation is a routine activity. It is one of the controls provided by legislation. Consequently, as this control is carried out, students go on to perform other language activities.

The teacher establishes the sequence of activities. He recognizes that of the time allotted to him is insufficient for completion of certain tasks, and reacts to students' complaints by having them finish this work at home.

When conduct is not up to standards, he censors or disapproves softly:

> "Try picking up a little bit, Elsa. You can't act that way systematically."

Interaction.-- As we say under the construct "management", Language classes are relationship-oriented. He has maintained interpersonal relationships with the students who have different problems.

Creativity is developed by stimulating divergent thinking. For this reason, he shows dissatisfaction at some of the answers given, seeking other new ones: "Let's see, what other solutions can you find...?"

Reflections.-- This is a teacher who makes pedagogical considerations on his instruction. He shows students the justification of his behavior or the interpretation of class problems and controversies. At the outset, we note his concern for the development of creativity. His Language classes should be occasions for fostering originality, as he has expressed over and over again. Let us look at one segment as a sample:

> "Yes, yes, that's fine. Er...personal initiative counts here too. There is more than one correct way to do the exercises. Ideally, the objective should not be to do the exercise well, as much as to have original answers -- but all good ones."

and in another class, he made the following comment:

> "Our language is a living, varying thing. It always has exceptions.... The idea is for you to give original answers... originality."

If he is speaking of originality here, further on he refers to imagination: "The aim is for you to imagine; to cultivate the imagination."

2. Conclusion

At the outset, through multimethod triangulation ( participant observation , interviews and journals on the class) an exhaustive verbal report has been obtained on 21 Elementary and Middle School teachers, practicing in the capital city of Seville, Spain, and in outlying small towns. The 510 elements were statements on the teachers' interactive teaching. The constructs were established by teacher-observer/interviewer. Following the grid technique, based on KELLY's theory of personal constructs, each subject evaluated 15 elements under each one of the construct pairs. These 12 construct pairs are explained in four factors. The 15 elements were reduced to three factors through factor analysis. Cluster analysis was also applied. As a result of this analysis, we agreed to reduce the information around these constructs: MOTIVATION-CREATIVITY, ACTIVITY, DIRECTION and INTERACTION. The correspondence between the factor and cluster analyses of the elements resulted in the selection of elements 2, 4, 7, 1, 9, 3, 10, 6, 8 and 11.

These elements are the ones which maintain this order in the list of each of the 32 matrices.

In this first part, we conclude with the proposal of a general map of reflections belonging to the ten element networks. The constructs were guiding ideas that structured the interpretation of three teachers' class teaching, selected from 6th, 7th and 8th grades (Mathematics, Science and Language).

Teachers M. T. R., A. A. O. and A. C. G. have shown reflections alluding to certain pedagogical theories. Most of their reflections revolve around the curriculum and instruction. The description of their teaching on the basis of the constructs identified also supports the previous assertion.

3. Implications

A) Methodological Approach.-- Our study has followed an ethnographical approach. We considered that this qualitative procedure could help us to establish a grounded theory (GLASER and STRAUSS, 1967) on interactive classs teaching.

Our method included characteristics of logical consistency, parsimony, clarity, but above all, generation. It was an inductively generated way of theorizing. Like functional theory, our study has also had inductive and deductive components of data analysis.

B) Teacher Training.-- This study has clear implications for initial and permanent teacher training. If we consider that initial training is a process of theory development in teachers, researching their thinking and action (SWANSON and COPA, 1984), we are making teachers look, in their professional lives, beyond the narrowness with which they describe what happens in class, or the intuitive, non-rational forms that guide their actions.

Some methodological aspects could be inserted in conferences in clinical supervision teacher training (HOFFMAN and EDWARDS, 1986), as attendants of these encounters may enter into clearly thoughtful conversations.

C) Curriculum and Instruction.-- This study has to do with class management (DOYLE, 1986), inasmuch as this concept relates to efficient teaching, teacher thinking, and the flow of the class. Our work has indicated the feel of class atmosphere based on indicators or constructs.

We have considered order in the class -- standards and procedures -- and how the hidden curriculum operates (some class norms relate to conflicts of authority, responsibility, and disposition towards the task at hand). We have also seen some structuring of classes with respect to instruction time.

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